subscript to the decimals; that Gunter and Wingate followed Napier, while Oughtred adopted Briggs's method and made an improvement in the mode of *printing* it. Napier has left so many instances of the decimal point as to render it pretty certain that he thoroughly appreciated its use; and there is every reason to believe that Briggs had, in 1619, an equal command over his separator, although there are not enough printed instances of that date to prove it so conclusively as in Napier's case (there is no instance in the "Lucubrationes" in which a quantity begins with a decimal point, and there could not well be one). Napier did not use the decimal point in the "Descriptio" (1614), nor in his book of arithmetic first printed under the editorship of Mr. Mark Napier in 1839, and there is only the single doubtful case in the "Rabdologia," 1617, so that there is reason to believe that he did not regard it as generally applicable in ordinary arithmetic. The only previous publication of Briggs's that I have seen was his "Chilias," 1617, which contains no letterpress at all. The fact that Napier and Briggs use different separating notations is an argument against either having been indebted to the other, as whoever adopted the other's views would probably have accepted his separator too. It is doubtful whether, if Napier had written an ordinary arithmetic at the close of his life he would have used his decimal point. Wingate employed the decimal point with much more boldness, and regarded it much more in the light of a permanent symbol of arithmetic than did (or could) Napier. The Napierian point and the Briggian separator differ but little in writing, and as far as MS. work is concerned it is quite easy to see why many should have considered the latter preferable, for it was clear and interfered with no existing mark. A point is the simplest separator possible, but it had already another use in language. In all the editions of Oughtred's "Clavis" (which work held its ground till the beginning of the last century) the rectangular separator was used, and it is not unlikely that it was ultimately given up for the same reason as that which I believe will lead to the abandonment of the similar sign now used in certain English books to denote factorials, viz., because it was troublesome to *print*. But be this as it may, it is not a little remarkable that the first separator used (or more strictly, one of the first two) should have been that which was finally adopted after a long period of disuse. All through the seventeenth century exponential works seem to have been common, on which see the accounts in Sir Jonas Moore's "Moor's Arithmetick," London, 1660, p. 10; and Samuel Jeake's "Compleat Body of Arithmetick," London, 1701 (written in 1674), p. 208, which are unfortunately too long to quote in this abstract. In his account Peacock is inaccurate in saying that the "Logarithmicall Arithmetike" was published by Gellibrand and others, the mistake having arisen, no doubt, from a confusion with the "Trigonometria Britannica," 1633; and in any case the reference is not a good one, as the "Arithmetike" of 1631 shows (for reasons which must be passed over here) a less knowledge of decimal arithmetic than do any of the chief logarithmic works of this period. Also Briggs died in 1631, not 1630.

There is no doubt, whatever, that decimal fractions were first introduced by Stevinus in his tract, "La Disme." De Morgan ("Arithmetical Books," p. 27) is quite right in his inference that it appeared in French in 1585, attached to the "Pratique d'Arithmétique." A copy of this work (1585) with "La Disme" appended, is now in the British Museum. On the title-page of the "Disme" are the words "Premierement descripte en Flameng, et maintenant conuertie en Francois, par Simon Stevin de Bruges." These words appearing also in Albert Girard's collected edition of Stevinus's works (1634) no doubt gave rise to De Morgan's inference that "the method of decimal fractions was announced before 1585 in Dutch." The Cambridge University Library possesses a 1585 copy, entitled "De Thiende… Beschreven door Simon Stevin van Brugghe….Tot Leyden. By Christoffel Plantijn, M.D. LXXXV." (privilege, dated December 20, 1584), and there seems every reason to believe, in the absence of any evidence to the contrary, that this was the first edition of this celebrated tract. Peacock's statement that "it was first published in Flemish about the year 1590, and afterwards translated into barbarous French by Simon of Bruges" is also, I suspect, founded on no other evidence than the sentence on the title-page of the "Disme," which appears also in Girard. De Morgan rightly remarks that Simon of Bruges is Stevinus himself, but he cannot tell whence Peacock derived the date 1590. It is probable that it was merely a rough estimate obtained by considering the dates of the other works of Stevinus.

Stevinus's method involved the use of his cumbrous exponents. Thus he wrote 27·847 as 27(0)8(1)4(2)7(3)[*] and read it 27 commencements, 8 primes, 4 seconds, 7 thirds; and the question chiefly noticed in this abstract is the consideration of who first saw that by a simple notation the exponents might be omitted, and introduced this abbreviation into arithmetic.

Napier's "Rabdologia" was translated into several languages soon after its appearance, and I have taken some pains to examine the different ways in which the translators treated the example which Peacock regarded as the first use of the decimal point, as we can thereby infer something with regard to the state of decimal arithmetic in the different countries. Napier (1617) wrote 1993,273 in the work, and $1993,2'7''3'''$ in the text. In Locatello's translation (Verona, 1623) this is just reversed, viz. there is $1993.2'7''3'''$ in the work, and 1993,273 in the text. The Lyons edition (1626) has 1993,273 in the work, and 1993,2(1)7(2)3(3)[†] in the text, while De Decker's edition (Gouda, 1626) has 1993,273 in the work, and in the text 1993(0)2(1)7(2)3(3), the last being exactly as Stevinus would have written it. Ursinus's "Rhabdologia," Berlin, 1623, is not an exact translation, and the example in question does not occur there.

SANITARY PROGRESS[‡]

SANITARY science is a thing of yesterday, comparatively speaking; but sanitary art, the art of preserving the health, whether of individuals or of communities, has been studied and practised for ages. Sanitary science is the latest and highest development of medicine. I say it is the highest branch of medical science because of the extreme importance of its objects, and I may also add of its results. It is the study of the causes of diseases, and it points out the means of preventing them; and I am sure you are all agreed that "prevention is better than cure;" as Rollet of Lyons well said, "Medicine cures individuals, hygiene saves the masses." But while we contrast hygiene (another name for sanitary science) with curative medicine, we must not forget that it is altogether a medical science, and that its great lights have been all medical men (mind, I am not speaking of the art now, but of the science), and this is necessarily so, and always must be so. I have said that sanitary science is the study of the causes of diseases, of the modes in which they originate, and in which they spread from one person or place to another. It is therefore only those who are acquainted with disease, that are competent to deal with it all, and these are those who have made medical science generally their special subject. You sometimes hear it said that medical men don't know much about diseases. Just think what this means; disease has been studied by earnest men in all its various forms for thousands of years; experiences have been recorded, comparisons made; the effects of remedies noted from generation to generation, and yet we are asked to believe that medical men don't know anything about diseases; the thing is absurd on the face of it.

Sanitary science is, then, a medical science, and the most intimate acquaintance with diseases is necessary for its prosecution —I mean for its advancement as a science. Sanitary investigations can only be scientifically conducted by medical men, just as pianos can only be played by musicians. This science is also the latest development of medical science. We must understand simple things before we can study complex ones. It is little use for a boy to study higher algebra until he has mastered the rule of three; and so pathology, or the study of diseased actions, becomes more and more advanced as physiology—the study of normal healthy actions—is more scientifically pursued; while the study of sanitary matters in a scientific way has only become possible of later years from the great advances made in the study of pathology, physiology, and chemistry; but being possible, it has made such rapid strides, and evolved such startling facts with regard to the causes of diseases, that it has become the popular subject of the day. Everyone thinks that he is competent to speak about it, and everyone who wants to make an effective discourse must needs take upon himself to expound some, to him, new view of sanitary matters; this is very mischievous. A man may do more harm by giving the weight of his authority to erroneous views respecting the method to be employed for the prevention of diseases than he has done good during the whole of his life in any other way. None but those who have made a special study of this subject have a right to speak on it, or at any rate have a right to influence the public mind with regard to it. The amount of good which may be done by the exposition of correct views on sanitary matters is incalculable; the amount of evil done by the enunciation of erroneous views, backed by apparent authority, fearful.

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[*] Stevinus enclosed the exponent-numbers in complete circles, which have been replaced above, for convenience of printing, by parentheses.

[†] These parentheses are printed instead of the circles which appear in these works as in Stevinus.

[‡] Abstract of the Inaugural Lecture delivered at the Town Hall, Birmingham, Thursday evening, Oct. 9, 1873, by Prof. Corfield, M.D. Oxon.

But if sanitary science is a thing of yesterday, such is not the case with the observation of sanitary facts, nor with the practice of sanitary art; and, while it is true that sanitary science is essentially and entirely a medical study, and is necessarily so, it is equally true that the practice of the art of preserving the health is not only possible to all, but is a duty which devolves upon all. In all ages we have had writers on this subject. From all countries we may learn useful lessons about it. From the times of Hippocrates, Galen, and Celsus, we have had records of the results of observations on the methods of preserving the health; from the time of Moses we have had lawgivers imposing salutary conditions of existence upon unwilling, because ignorant populations. We look upon the immense engineering works undertaken and carried out by the Romans to supply their towns with pure water with astonishment, when we turn round and see our own towns supplied from polluted rivers, or, worse still, from shallow wells dug in the soil upon which they themselves stand, wells supplied in most cases chiefly by the foul water which has percolated from the surface of the ground. We have found out in later times that one of the main conditions of the health of communities depends on the purity of the drinking water, and we see that the Roman engineers, by having to go to a considerable distance for water in order to get it to a sufficient height in their cities, accidentally, as it were, fulfilled one of the most important of sanitary requirements.

"Knowledge is power," and as we come to know more of the conditions which favour the spread of diseases, as we do daily, it is our own fault if we neglect to use the power which that knowledge gives us. There are two conditions of insalubrity which are pre-eminent. I hardly know which to place first. The one is overcrowding, and the other the accumulation of refuse matters in and about dwellings. These conditions were those which especially favoured the spread of the fearful plagues of the middle ages; as a result of over-crowding we have a deteriorated condition of the air, from the diminution of the amount of its most essential constituent, oxygen; and, worse still, we have it rendered foul by the exhalation of decomposing organic matters from the bodies of the persons breathing it. Such a state of air is especially favourable to the multiplication of the poisons of diseases; such a state of the air is also brought about by the non-removal of refuse matters from the vicinity of habitations. Dr. Laycock tells us that the plague in York in each of its visitations, and also the cholera, broke out in the same abominably filthy place; and in cholera epidemics it has been repeatedly noticed that those parts of towns which are most filthy and most over-crowded, always suffer worst.

But the danger is not only from special epidemic diseases. Such insanitary conditions induce a lowered vitality of the inhabitants, who become prone to attacks of diseases of all sorts; and then we have sickness, inability to work, and consequent inability to earn bread and to pay rents, and so the evil recoils from the tenants upon the landlords. One witness says, "Rent is the best got from healthy houses." Another, "Sickness at all times forms an excuse for the poorer part not paying their rent, and a reasonable excuse."

I consider that one of the most important conclusions that the study of sanitary science has forced upon us lately is the conclusion that the immediate removal of refuse matters is one of the first necessities of the healthy existence of a community. There are those who would have you believe that refuse matters may be rendered innocuous in one way or another, so that they may be kept with safety in and near to houses. Don't listen to them; the principle is wrong—radically wrong. Depend upon it that the true method is to get rid of such matters at once, and in the simplest possible way, and that is the cheapest plan in the end. Show me a town where refuse matters are kept—no matter how they are treated—and I will show you a town where the standard of vitality is low; I will show you a town with a high death-rate, especially among children.

To take the other side of the question, look at London. There you have a population of 3¼ millions, with the lowest death-rate of any very large collected population in the world, with one of the lowest death-rates among the large towns of even our own country. Why is this? I say unhesitatingly, and without fear of contradiction, that with all allowances made for the excellent position of London, it is mainly due to the fact that the principle there, however incompletely it may be carried out, is the immediate removal of all refuse matters; in London, the water-carriage system, by which the foul water containing a very large proportion of the refuse matters of the population, is removed by gravitation in sewers, is carried out far more perfectly than in any other large town, and this system is daily being rendered more perfect there; it is the right system based upon a true principle, and its results are most salutary. When you have got rid of refuse matters, then see what you can do with them; and here arises a very curious consideration. Sewers, in most instances, were not originally built as sewers, but as drains; a sewer is a conduit for the removal of fouled water; a drain is a channel for the removal of mere superfluous water, the object being to dry the soil. The pattern of all our old sewers, the Cloaca Maxima at Rome, was originally a drain; it was constructed by Tarquinius Priscus, the fifth King of Rome, 600 years B.C., to drain the marshy ground between the Palatine and Capitoline hills, and it was so well constructed that it drains that ground at this moment. Pliny wondered that it had endured 700 years unaffected by earthquakes, by inundations of the Tiber, by masses which had rolled into its channel, and by the weight of the ruins which had fallen over it. What would he say could he see it now, as any of you may who choose to go to Rome, still discharging, after more than 2,400 years, its dirty water into the Tiber? But the convenience of the great drain for the disposal of refuse matters soon became apparent, and so it was turned into a sewer, and has been one ever since.

Well, what are we to do with the refuse sewer water, when we have got it out of our towns? This is one of the greatest questions of the day. Drains, of course, were naturally made to discharge into rivers, their proper place, so long as they were only drains; but when they come to be used as sewers, this will not do; in the first place the rivers are fouled, and in the next the manure is lost. I shall be able to show you in the course of the lecture that the only way known by which sewer water can be either purified or utilised, is by turning it, with suitable precautions, on to land, that this may be done, not only without injury to the health of the neighbourhood, but with great benefit in many ways.

We have spoken of drains to dry the soil; what is the necessity of this? Every farmer knows that crops will not flourish on undrained land; neither can human beings; a damp house is a synonym for an unhealthy house, you all know that; but it is only within the last few years, as the result of a most important sanitary research, made by Dr. Buchanan, that we have come to know as a scientific fact, beyond all dispute, that the drying of the soil of a town reduces the number of deaths from consumption in a most extraordinary manner; in some towns the number of deaths under this head has been reduced by one-third or even by one-half, in this way.

To mention some other special diseases which have been successfully combatted of late years, look at scurvy, that terrible malady which formerly decimated our navies! We know now that that disease may be prevented by the use of limejuice as part of the daily food, and we are no longer afraid of it. (Some illustrations of the ravages of this disease were given.)

Look at small-pox, beyond all exception the most fearful epidemic disease with which the world was ever afflicted! We know how to prevent it, and we have recently had a very severe lesson from not applying that knowledge. It is to the immortal credit of England that Jenner, the discoverer of vaccination, was an Englishman; there are certain people, and they have actually formed a society, who are trying to get compulsory vaccination done away with in this country. Let me tell you that if there is one fact established in preventive medicine it is that vaccination affords a protection from small-pox; let me tell you that this statement is founded upon an induction such as has been brought to bear upon no other subject in medical science; and, let me add, that those persons who bring isolated facts as arguments against a statement so supported, show that they have no idea of the nature of an inductive argument at all. An unvaccinated person is a danger to the community, and ought not to be allowed to go at large, and so far from persons being merely fined for not allowing their children to be vaccinated, and then permitted to keep them unvaccinated, the children ought to be vaccinated by the public vaccinator, even in spite of their parents, who should not be allowed to risk their children's lives through their own obstinacy and ignorance; and not only their children's lives, but those of the persons around them. The recent epidemic of small-pox showed us several important things—it showed us what we knew before, that small-pox is far more fatal to unvaccinated than to vaccinated persons; it showed us that while small-pox is especially fatal to unvaccinated children, it is less fatal to vaccinated children than to other persons; thus demonstrating the necessity of re-vaccination, and it showed us that re-vaccination once performed is actually a better protection against small-pox than a previous attack of small-pox is. You know that it is not common for a person to have small-pox twice. Well, it is much less common for a person to have small-pox after he has been successfully re-vaccinated, and if he has it is almost certain to be a very mild attack. Out of nearly 15,000 cases of small-pox admitted into various London hospitals during the late epidemic, only four presented proof of having been re-vaccinated.

Let us pass on to typhoid fever. Here is a disease of the very existence of which, as distinct from certain other diseases, we have only known in recent times, but yet a disease about which, thanks to the researches of men now among us, one of whom it especially becomes me, as his pupil to mention, Sir William Jenner, we really seem to know more than about almost any other disease; a disease which we deliberately hunt down to its source, and stop just as we could stop the supply of stone from a quarry or of rifles from an armoury; a disease, the haunts and habits of which we know with such accuracy that we are able to go into a house and say, "Alter this, and alter that, or you will very likely get typhoid fever here," a disease the ways of which we know so well, that, when there has been a case of it caused by local defects in a house, we can almost predict what alterations are required without going to the place. Surely the results obtained from the study of this disease are some of the most striking results of sanitary progress in our day. I find that the idea has become widely spread that the recent epidemic of typhoid fever in London was due to the distribution of milk from a sewage farm; this was not so, and I regard it most in the light of a special providence that none of the milk sent out from that establishment came from a sewage farm: had it been so, such a fact, combined with the prejudice and ignorance which exists upon the matter, would have dealt a severe blow to the progress of one of the greatest sanitary improvements of the day. The cause of that epidemic is known with absolute certainty, the very channel by which the poison got into the dairy well having been recently unearthed.

I must allude, for an instant, to the recent sanitary legislation; it has been found fault with by many on account of matters of detail; but consider the fact that the result of it is that the country has spent a large sum of money in the employment of medical officers of health and sanitary inspectors, and that such men now exist, and you will see that in it we may find great cause for rejoicing when looking to the future of sanitary progress. In a lecture on the "History of Hygiene," which I delivered some three or four years ago at University College, London, I said, "From its very nature, hygiene interests all classes of society; but it is to those who are worst off—the poorest and most wretched—that it must direct its first attention. Civilisation has its evils as well as its advantages, as Bouchardat has well remarked; and one of the greatest of them is the over-crowding of people in the great centres of population, with the misery and disease which are the results of it. It is to better constructed houses for the working classes, to a free supply of good water, and to satisfactory sewerage arrangements, that we must look for an amelioration in these respects; and I would hasten to add, to a wider spread among those classes of such an education as shall lead them to appreciate the means used for the improvement of their condition, and to lend a helping hand for the furtherance of those means."

I feel that I cannot do better in conclusion than congratulate this town on having, through the munificence of one of its citizens, been the first to appreciate the importance of the education of the people in these subjects, and on having such an institution as this in which so much useful knowledge is imparted to the people, and congratulate myself on having the privilege of such an opportunity of spreading broadcast the great truths of sanitary science. The time is fast coming which was looked forward to by Dr. Parkes when he wrote:—"Let us hope that matters of such great moment may not always be considered as of less importance than the 'languages of extinct nations, or the unimportant facts of a dead history."

SCIENTIFIC SERIALS

THE current *Ibis* commences with the latter part of Mr. Brooke's notes on the ornithology of Sardinia, special attention being drawn to *Otis tetrax*, which is moderately common; *Phœnicopterus roseus*, which occurs in large flocks during the winter and even up to June; the presence of *P. erithacus* is doubtful. *Fulica nigrosa* was not seen, though included in both Cara's and Salvadori's lists. In the museum there are several specimens o *Phalacrocorax desmarestii*, and *P. carbo* is extremely common. *Larus audouini* is found, though very rarely.—Captain F. W. Hutton, in a note on *Rallus modestus* of New Zealand, gives evidence to show that Dr. Buller is in error when he considers *R. modestus* to be *R. dieffenbachii*, in an immature state of plumage, as the proportions of the chicks are different, and the bill of the latter more slender.—Messrs. Salvin and Elliot in continuation of their notes on the *Trochilidæ*, discuss the genus *Thalurania*, which is exclusively tropical, and consists of eleven species and five sections.—In notes on Chinese ornithology, Mr. R. Swinhoe draws special attention to *Ceryle rudis* at Ningpo, *Gallinago solitaria*, *Endrominas veredus*, and other land as well as water-birds found at Shanghai.—Mr. Sclater supplements Mr. Salvin's list of the birds of Nicaragua, with additions from a recent small collection made by Mr. Belt, adding seventeen species, mostly well known through Central America.—Mr. E. L. Layard gives notes of the birds observed in Para; and Mr. Sclater describes and figures two new species named by him *Picolaptes layardi*, and *Thamnophilus simplex*.—Captain J. H. Lloyd on the birds in the province of Kattiawar in West India, commences the detailed account with an interesting comment on the general ornithological description of the region.

THE *Monthly Microscopical Journal* for October, commences with a description, by Mr. F. H. Welch, of the thread-worm *Filaria immitis*, occasionally infesting the vascular system of the dog, with remarks on the same, relative to Haematozoa in general, and the Filaria in the human blood. The specimens described were obtained from the right ventricle and pulmonary artery of a dog, from Shanghai, the male, female, and young being described. The left ventricle also contained some of the young.—Dr. Royston-Pigott fully illustrates a paper entitled "Researches in Solar Spectra, applied to test residuary aberration in microscopes and telescopes; and the construction of a compensating eye-piece, being a sequel to the paper on a searcher for aplanatic images."—Dr. Rutherford describes a new freezing microtome in which the freezing box and escape tube are much larger than in his older instrument, and the indicator is improved.—Mr. Ch. Stodder, in a letter, points out that it is inaccurate to suppose that the nominal price of American objectives is directly comparable with that of English makers, as the value of money in the two countries is so different, and duty has to be paid on entering the former.

Annali di Chimica applicata alla Medicina, July number, 1873.—We notice in this journal, besides a number of formulæ for pharmaceutical preparations and other details interesting to the druggist, a paper by A. Gubler, on experiments with new and old opium alkaloids, which deals, amongst others, with apomorphia.—There is also a translation of Mr. Simon's memorandum on the diffusion of cholera, and other papers from native and foreign sources. In the *Rendiconto delle sessioni dell' Academia delle scienze dell' Istituto di Bologna*, 1872–1873," are given briefly (in about 189 pages) abstracts of the papers read before the Society, together with other matter of the usual nature.

Reale Istituto Lombardo di scienze e Lettre Rendiconti, Fascicolo xiii.," July 1873.—This number contains several critical literary, historical, and philosophical papers, including one on Kant's philosophy, by C. Cantoni.—In the scientific section there is a paper by Prof. Cavalleri on improvements in the helioscope, and a portion of a paper by P. Cantoni on electrical adherence, which is illustrated with several tables of data.—Fascicolo xiv. contains a paper on the capacity of the nasal fossa, by P Mantegazza, and one on cholera by G. Strambio.—C. Lombroso details some experiments on the tonic action of